from Mr. Smith to J. R. [illegible]

EXAMINATION

OF

COL. REID'S WORK ON THE LAW OF STORMS.

BY JAMES P. ESPY.

1785 – 1860

My friend, President A. D. Bache, on his return from Europe, put into my hands a highly interesting work by Lt. Col. W. Reid, C. B., of the Royal Engineers, being "An attempt to develope the law of storms, by means of facts, arranged according to place and time, and hence to point out a cause for the variable winds, with a view to practical use in navigation."

This work is illustrated by charts showing the direction in which the various storms investigated moved along the surface of the sea, and showing the locality of the ships whose logs are given in the body of the work.

This work furnishes many additional proofs of that beautiful generalization first hinted at by Franklin, afterwards by Dr. Mitchell, of New York, and lately established in the most satisfactory manner, according to the true principle of inductive philosophy, by Wm. Redfield, of New York: namely, "*Great storms which originate in the windward Islands of the West Indies; progress from the place of commencement in a curve towards the N. W., till on reaching the lat. of 30° N., when they are moving nearly towards the N., their motion after this is towards the N. E. as far as traced.*[*]

From all the facts collected by Mr. Redfield, by the joint Committee of the American Philosophical Society and the Franklin Institute, and by Col. Reid, it would seem that these storms constantly become wider and wider, from their place of commencement, and perhaps elongated in their N. E. and S. W. diameter after they reach a lat. as high as 40° or 45°.

Col. Reid agrees with Col. Capper and Mr. Redfield, that these storms are in the form of great whirlwinds; and Sir John Herschel who is of the same opinion, "does not see how Mr. Espy's theory, though he considers it ingenious, is tenable against the indications of the barometer, for unquestionably if a large body of air, he says, were to set on every side inwards towards a central ascending column, the necessary effect would be an increase of weight of the entire barometric column."

Now this objection is so obvious, that any theory, which has no answer for it, or which does not contain an answer to it in itself, does not deserve the name of ingenious; and it arises from so imperfect or inaccurate a view of the doctrine which I teach, that I am sure as soon as Sir John shall see my papers on the subject, he will see and confess that the objection has already been fully answered. If I am right in this matter, Sir John owes it not merely to me, but to the cause of science, on a point which he acknowledges to be of immense importance, to come out and correct his mistake; for such is the weight of his name, that many will not think it worth while to examine a system which has been condemned by Sir John Herschel.

As to Col. Reid, his whole book is a proof that he is much fonder of truth than of theory. He will therefore do me justice. I was highly delighted when this book came into my hands; for I saw immediately that it contained a great many facts and simultaneous observations, which would enable me at once to put my theory to a very severe test.

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[*] Perhaps they sometimes turn E. or even S. E.

On reading the logs of the several ships, I kept the map of the particular storm open before me, and, drew my pencil across the point where the ship was, drawing an arrow so as to exhibit to the eye which way the wind was blowing at that time in that locality.

When several logs were read, and arrows made in every locality—I was not a little pleased to see, in all the storms, decided proofs of an inward motion of the air, if not exactly to one common centre, quite as nearly so as any one had a right to expect; because oblique forces are known to exist, which must vary the direction of the wind. I shall now give a few examples of that period of the several storms, in which I find the most simultaneous observations.

Savannah la Mar Hurricane of 3d Oct., 1780.

About 1 P. M., at Savanna la Mar, on the 3d, the gale began from the S. E. and continued with increasing violence until four in the afternoon, when it veered to the S., and became a perfect tempest, which lasted in force till about eight; it then abated. The sea during the last period exhibited a most awful scene; the waves swelled to an amazing height, rushed with an impetuosity not to be described on the land, and in a few minutes determined the fate of all the houses in the bay.

Log of the Badger, at Lucia Bay, Jamaica.

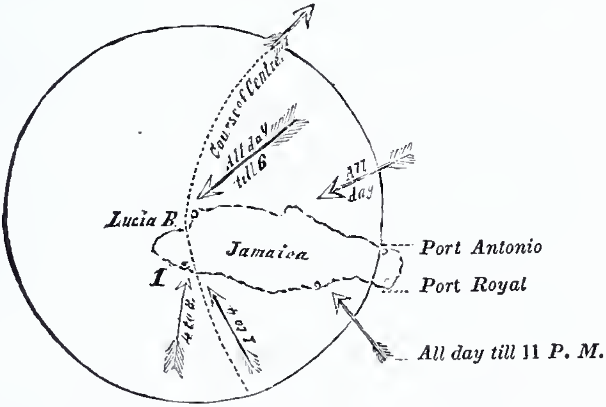
P. M., of 2d, moderate wind, N. E., at 9 hard rain, and continued raining all night with squally weather; at 10 A. M., of the 3d, tripped our anchor, let her drive within the point of the Fort till it bore N. by E., distant three quarters of a mile, and the eastermost N. E. by N., distance one mile and a half; heavy squalls with hard rain; down top-gallant sails.—1 P. M , wind N. E. let go the sheet anchor in five and a half fathoms; muddy; veered the cable, and brought both anchors ahead; continued very heavy gales with hard rain. At 4, let go another anchor. At 3.30 both sheet and bower anchors came home; veered away the clink round the mast, when the best cable parted and then immediately the sheet cable parted likewise. At 5, she was driving on shore very fast, when a gust of wind laid her down, with the comings of the hatchway in the water. By consent of the captain and officers, cut away the weather halyard to the main shrowds, when the main mast went about twenty feet above deck; she immediately righted, and drove broad-side on shore, abreast of the town; the sea making a free passage over us, when our boat went to pieces along side. At 5.30 cut the bower cable to let her swing end on. About 6 it fell calm for half an hour, when the wind shifted round to S. W., blowing a hurricane with strong flashes of lightning. At 10, it became quite moderate.

The Phœnix, off Port Antonio.

When the Phœnix was in company with the Barbadoes, off Port Antonio, the wind began to blow, with a stormy appearance, to the eastward, about 11 at night of the 2d of October, and the Phœnix then close reefed her top-sails. At 8 on the morning of the 3d, the wind was E. N. E. with occasional heavy squalls; and Sir Hyde Parker, who commanded the Phœnix, remarked that the weather had the same appearance as he had observed in the commencement of a hurricane in the East Indies. He then ordered the top-sails to be taken in, and wore the ship in order to keep mid channel between Jamaica and Cuba. At 2 P. M., the Phœnix lay-to, with a storm mizen stay-sail, and her head to the northward. When night set in, the storm increased with great violence. At midnight the wind was southeast, and the ship drawing upon Cuba, Sir Hyde Parker determined to wear her, but no canvass could withstand the wind at this time, and she was wore by sending 200 of the crew into the fore-rigging. When about to cut away the masts, the ship took the ground on the coast of Cuba; and it was 5 o'clock in the morning of the 4th of October.

Journal of Princess Royal, in Port Royal Harbour.

On 2d October, the wind was S. E. and E. S. E., A. M, and the people employed in caulking the ship's bottom. P. M. the wind was S. E. by E., and squally weather, with rain; people employed as before; violent squalls with heavy rain in the night, wind from the southeastward. On the 3d, A. M., the wind E. S. E. to S. E. and gale increasing with much rain; people employed in securing the ship; by the violence of the wind in the night the mizen-topsail, fore-top-gallantsail, and main-top-gallantsail, that were covering tents in the yard, and had been condemned by survey on the 30th of September, were entirely blown to pieces. P. M. wind S. S. E., and excessive hard squalls with thunder, lightning and rain; people employed as before. At midnight more moderate and light rain.



1. *Savannah la Mar; destroyed Oct.* 3, 1780.

These are all the data we have concerning this storm, yet it will be seen though we have no observations on the western half of this storm that the centre of it passed over Lucia bay, from 6 to 6½ P. M., and at that very time and for some time before and after, the wind on the other side of the island at Savannah la Mar, was blowing a hurricane from the south, exactly towards Lucia bay. The wind also at Port Royal in the southeast corner of the island was blowing nearly to the same point, and from the log of the Phœnix some place between the east end of Jamaica and Cuba the wind was violent E. N. E., almost exactly towards Lucia bay. The reader will observe that when the wind changed at Lucia bay, and with the Phœnix, all the four arrows, if drawn on the chart, would point to a spot near where the Phœnix was wrecked, not many hours afterwards, on Cuba.

Great Barbadoes Hurricane, of October 11, 1780.

At Carlisle bay, on the west side of Barbadoes, it was remarkably calm on the evening of the 9th October, but the sky was remarkably red and fiery. During the night much rain fell. On the morning of the 10th, much rain and wind from the N. W. By 10, it increased very much. By 4, P. M., the Albermarle frigate parted and went to sea, as did all the other vessels, about twenty-five in number. By 10 P. M., the wind forced itself a passage through the house from the N. N. W., and the tempest increased every minute.

At St. Lucia,

All the Barracks and other buildings in the island were blown down.

At St. Vincent,

Every building was blown down.

At the town of St. Pierre, in Martinique,

Every house was blown down, and more than 1000 people perished.

At Fort Royal,

1400 houses, besides the churches and public buildings, were blown down.

At St. Eustatia,

On the morning of 10th, at 11 o'clock, the sky on a sudden blackened all round; it looked as dismal as night, attended with the most violent rains, thunder, and lightning ever known before. In the afternoon the gale increased. In the night every house to the northward and southward, was blown down or washed away into the sea, a few only escaping. The houses on the east and west were not so much hurt, till the P. M. of the 11th, when the wind, on a sudden, shifted to the eastward; and at night it blew with redoubled fury, and swept away every house.

At Barbadoes,

It began to blow on the 9th, but on the evening of the 10th the wind rose to such a degree of violence, as clearly to amount to what is called a hurricane. At 8 P. M. it began to make impression on all the houses by tearing off the roofs, and overthrowing some of the walls. It was thought to be at its greatest height about midnight, and did not abate considerably until 8 next morning.

Log of the ship Albermarle, lying in Carlisle Bay, on the west side of Barbadoes.

On the afternoon of the 9th, wind E. moderate and hazy. Morning of 10th, E. N. E., blowing very hard. At 1 P. M., N. E. by N. strong gales with hard rain at times. The gale increasing, the officers decided to go to sea, which was done at 2 P. M., wind N. N. E. At 30 minutes past midnight, still blowing a hurricane, with rain, and wind shifting to westward. At 5 in the morning, of 11th, the wind shifted round to the southward, still blowing very hard, with constant rain. At noon, still blowing a hurricane, with hard rain. P. M. still blowing a hurricane, with wind S. E. by S., with constant heavy rain. At 4 saw the northwest end of Barbadoes bearing N. E. by N. distance 4 or 5 miles. At 4.30, wind shifted round to S.E. and heavy gales of wind with constant rain. At 5 A. M., of 12th, more moderate but fresh gales continued S. E. in P. M.

Log of the Vengeance.

Moored in Careenage on west side of St. Lucia. Dark cloudy weather on the afternoon of the 9th. The Blanche and Alcmene sailed at 6 A. M. of 10th. On the afternoon of 10th, strong squalls; at 7.30 P. M., very strong squalls, variable. At 9 P. M. the Ajax parted her cables and went out to sea. At 11 the gale increased very much. At 12 the Egmont slipped and went out to sea—wind variable all this time. At 4.30, A. M., of 11th, the Montagu slipped and ran out to sea. At 8.30, wind N. E., and the Amazon slipped and ran out to sea. Several transports drove on shore and dismasted in the harbour· At noon violent squalls and N. E. At 12.15, parted the small bower and brought up with the stream and sheet anchors. . . . . Cut away the long boat, cutter, and schooner tender, which were immediately dashed to pieces; the hurricane still increasing and the ship striking at times. At 8, wind N. E. by E., and veering round to eastward. At 9, lightning between the squalls, still blowing excessively hard, with rain. At 10, less wind with more rain and lightning. At 12, the hurricane abated with rain. At 4 on morning of 12th strong gales and squally, with heavy rain. At 11 A. M. wind E. S. E. In the afternoon, wind E. S. E., moderate, with rain. At 8, thunder and lightning and rain.

Log of the Alcmene.

At 1 P. M., of 10th, wind N. N. E.; fresh breeze and squally. At 2 P. M. got under way from the Careenage in St. Lucia, in company with the Blanche. At 5 P. M., N.½E., Martinique E.½N., 6 leagues. At 8, N. by E. At 10 N. N. E. At 3 in the morning of 11th, N. by E., hard gales and rain. At 7 N. N. E. At 10, very hard gales and rain; great sea. At 1 P. M., hard gales and thick weather with rain, wind variable. At 4, lost sight of the Blanche bearing S. S. E. half a mile. From 5 till 9, wind N. W. and gale increasing. At 12, gale still increasing, and wind S. E., from 10. At 3 A. M., of 12th, wind S. W. At 7, wind S. by W. At 10, gale abated, saw a ship ahead, supposed to be the Blanche. At 1 P. M., wind S. S. E., fresh gales and squally. At 3 P. M., wind S. E. At 10, saw Martinique E. by N., 5 leagues.

Log of the Egmont.

At 10 A. M. of the 10th, squally and wind variable. At 12, northwardly squally and hard rain, sailed from the Careenage in St. Lucia in company with the Blanche and Alcmene. At 1 P. M., wind N. by N. fresh gales and squally, with rain. At 6 P. M., E. N. E. At 7, came on a heavy squall of wind with rain, which parted the small bower cable at twenty fathoms from the anchor. At 9, wind N. At 10, N. by W. At 11.30, cut away the best bower at a whole cable and went to sea. Midnight N. E. by N., split the main topmast-stay sail. At 4 A. M. of 11th, strong gales with hard squalls of rain. At 7 carried away the main-staysail. At 8 A. M., wind N. by W. At noon, St. Lucia, N. 19° E., distance thirteen leagues. At 1 P. M. of 11th, wind N. E., very strong gales with hard squalls and rain. From 10 at night till 8 next morning while the storm was most violent the wind was from all quarters. It then became S. S. E and S. E., and so continued till the end of the storm. At noon of 12th, St. Lucia, N. E. by E.¾E. distance eleven leagues.

Log of the Montagu, lying off the entrance of the Careenage, St Lucia.

On P. M. of 10th, wind N., strong gales with heavy squalls of rain and a heavy swell from N. W. At midnight parted or slipped ship Ajax. At 3 A. M. of 11th, slipped and put to sea the ship Egmont. At 5.30, in preparing to slip and put to sea, we parted our stream and small bower cables; stood out W. N. W. till 8 A. M. South end of St. Lucia then bore S. S. E., nine or ten leagues, wind N. N. E., brought her to with her head to the northward, up N. W., off W. by N., very strong gales. At 1 P. M., wind N. N. E., a very heavy storm, with rain. At 3.30, in cutting the main and fore-topmast, the mainmast, fore and mizenmast, all went over the side; a heavy storm of rain. At 4.15, the bowspit went by the outer gammon, and carried away the greater part of the head. At 6 and 8, wind N. by W., weather the same, and very high sea. At 5 A. M., wind W. S. W. and more moderate. At 9 A. M. saw the Sugar Loaves of St. Lucia bearing E.½N., distance four leagues; the Island of St. Vincent then E. S. E., distance six leagues. At noon moderate breezes and high sea, cloudy with rain—Sugar Loaves E., distance two leagues.

Log of the Amazon, in the Careenage.

On the afternoon of 10th, fresh breezes with hard squalls. At 6 P. M. the Egmont parted, and brought up again under our stern. At 9, the Ajax put to sea. At 11, the Egmont cut and put to sea; excessive hard gales with rain. At 4 A. M., wind northeasterly, the Montagu parted and put to sea. At 7.30, finding the gale increase, slipped the small bower and stream cables, and cut the best and put to sea. Noon, blowing a hurricane with a heavy sea. At 2 P. M., blowing a perfect hurricane N. E. At 7.30, by the violence of the hurricane the ship overset, and lay in that situation 7 or 8 minutes. At 8, the wind N. W., and ship quite righted with 10 feet water in the hold. At 2 A, M. of 12th, pumps choaked with seven feet water in the hold. At 4 A. M., found the wind abate. At noon, wind N. N. W., gale much abated. In P. M., wind E. by S., first part hard gales with rain. At 5, wind had been quite round the compass in the last twenty-four hours. On the afternoon of 13th, wind still E. by S. with fresh gales and hazy weather with rain. At 6, the body of Martinique E. by S. distance eight or ten leagues.

Log of the Endymion, N. N. E. of Martinico.

On the afternoon of the 10th, wind N. E. strong gales and hard squalls. At 4, saw the N. E. end of Martinico S. W. by S., distance seven leagues. At midnight, strong gales continue. At 8 A. M. of 11th, wind E. N. E. heavy gales and strong squalls. At noon blows strong and violent squalls, N. E. end of Martinico W. S. W., distance four leagues. At 1 P. M., wind E. N. E., strong gales and hard squalls. At 3 A. M. of 12th, just weathered the island of Caraval, the N. E. end of Martinico. At 5, the wind E. At 7, wind E. by N., hove-to under a mizen topsail. At noon, wind E. S. E., continuing a heavy gale and violent squalls.—N. end of Martinico, distance fifteen leagues.

To these particulars extracted from Col. Reid, I am enabled to add the following from the Pennsylvania Gazette of 1780.

Pennsylvania Gazette of December 13, 1780.

At Bridgetown, Barbadoes, (which is on the southwest side) the wind began to blow very fresh soon after daybreak of Tuesday the 10th of October, and increased till 4 o'clock next morning. The wind during the greater part of the hurricane, blew from the N. E. quarter, and never shifted to the southward further than S. E.

From the same paper of December 6.

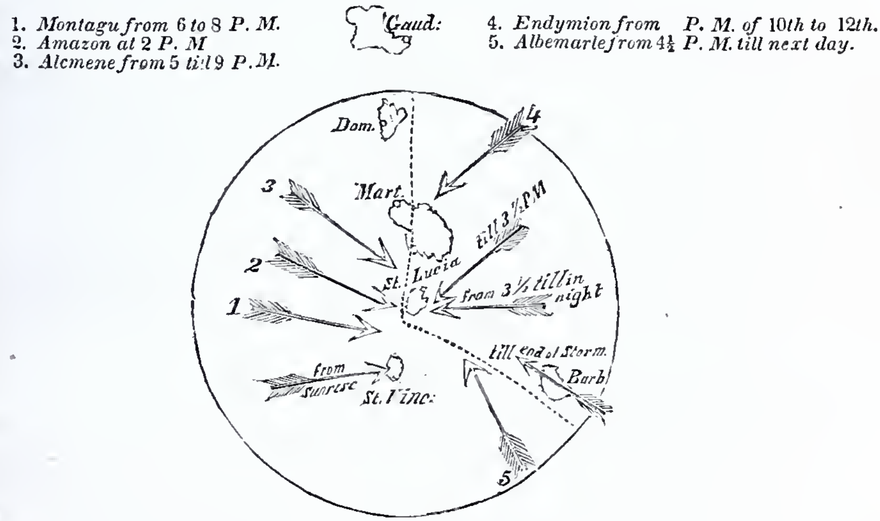
On the 10th at St. Pierre, on the west side of Martinique, a sudden gale sprung up from N. E., and though the gale increased and continued without intermission, the shipping kept their stations as the wind blew off the land till the 11th. On the night of the 11th, the wind shifted to the southward, and after continuing there two or three hours, shifted to the S. W. and blew right on shore. Between 2 and 3 o'clock of the morning of the 12th. the sea was thrown into the most violent agitation, and raged with incredible fury and destroyed many houses and stores on the bay.

At St. Christophers the wind abated on Saturday the 14th, but about 8 o'clock it changed to the southward, and drove the Minerva on shore. At Bassetere, St. Christophers, it began a gale about midnight of Wednesday the 11th and increased all next day.

Same Paper of December 20.

At St. Vincents the wind came round to N. W. on Tuesday night the 10th, and blew very fresh all night from that quarter. At sunrise it came rather more to the westward, and the gale increased, and from 12 till 4 P. M. there never was such a scene. The wind began to abate at 5 P. M.

Great Barbadoes Hurricane, Oct 11th, 1780.


1. *Montagu from 6 to 8 P. M.*
2. *Amazon at 2 P. M*
3. *Alcmene from 5 till 9 P. M.*
Gaud:
4. *Endymion from P. M. of 10th to 12th.*
5. *Albemarle from 4½ P. M. till next day.*
Dom.
4
3
Mart.
till 3½ P.M
2
St. Lucia
from 3½ till in night
1
till end of Storm.
from sunrise
St. Vinc:
Barb
5

The dotted line is the course which the centre of the storm moved in.

By casting the eye on the map which is intended to represent the locality of the storm at 6 P. M. of the 11th, it will be seen that all the arrows fairly within the action of the storm are directed inwards to a central space of no great magnitude.

This action lasted for several hours of the evening of the 11th; and did not vary until the centre of the storm, towards midnight, passed the Alcmene, the Egmont, and the Montagu, in its motion towards the N. W. And it is worthy of particular remark that as the storm passed on, the wind to all these vessels changed round to the S. E., as it had already done at Barbadoes, and to the Albamarle near Barbadoes.

Now as the centre of the storm passed over or very near all these places, it will readily be perceived that the manner in which the wind changed, accords exactly with the idea, that the wind blows inwards towards the centre of these storms; and not at all with the notion that it blows in the form of a whirlwind. When I take up some of the other storms I shall notice this fact more particularly. I shall only mention here that Mr. Edwards says, in the third volume of his History of Jamaica, that "*all hurricanes begin from the N., veer back to the W. N. W., W., and S. S. W., and when got* *round to S. E. the foul weather breaks up.*" And Col. Capper in speaking of a great hurricane which occurred on the coast of Coromandel, on the 29th October, 1768, page 60, says "the wind began from the N. W. *as is usual at the commencement of these hurricanes.*"

I shall not give charts of this storm for the subsequent days; but if any one who has Col. Reid's book will read the logs of the Endymion, and the Convert, and the Egmont, and the Diamond, for the 15th and 16th, he will find, if he draws arrows on the charts representing the direction of the wind on these several days, a remarkable convergence towards the centre of the storm. And if he extends his observations to the 17th and 18th, he may include the Grafton with the ships mentioned before. Now as these ships were several hundred miles apart, the evidence is conclusive, that on all these days the wind did blow inwards to the centre of the storm.

But there is one remarkable feature in this storm which must not be passed over in silence. Its centre in its motion turned out of its regular course and passed over Martinique a little after midnight of the 11th. At this time the Endymion, on the N.N.E. of that island had the wind violent from the E.N.E.; and at St. Pierre on the south-west side of the same island the wind was S. W. And the Alcmene some fifteen or twenty miles to the S. S. W. of the island, had the wind S. W. to S. S. W. about the same time for several hours. The intelligent reader will perceive how the wind from the N. E. striking on the eastern side of this island whose mountains are of considerable height, would glance upwards, and thus form a cloud over the island, and thus cause the centre of the storm to locate itself for a time over that island.

Antigua Hurricane of 2 *Aug.* 1837, *at Antigua.*

On the 2nd of August, between 2 and 3 A. M. we had a smart gale from north, which crept gradually round by the north-west, west, and south-west, until it died away in the south-east.

One barometer at Antigua, in the gale of the 2d, only sunk .43, another sunk .63.

At Nevis,

On the morning of August 2d, between 3 and 4, the wind being north, a shower of rain fell. At half-past 6, A. M. the wind began to rise until 8, it then shifted to the N. N. W. and gradually increased in gusts until 10, during which time much rain fell. The wind then veered to the westward, and next to due south, then back to south-west, and last backed to south again, from whence it blew steadily and with violence until 2, P. M., when it abated.

At St. Kitts,

Early on Wednesday morning, the 2d of August, the wind blew strong from the north, and indicated the forthcoming storm. At about 8, A. M. it veered to N. W. and shortly afterwards to west, during which time it blew a perfect gale, throwing a tremendous sea into the harbour, and threatening the destruction of every vessel.

At St. Bartholomew,

The storm commenced at north-east, and continued to increase in violence until 2 P. M.

At St. Martin,

A gale commenced about 9 A. M. and raged with great violence from 11 A. M. to 2 P. M., veering from E. N. E. to N. W.

At Santa Cruz,

On Monday the 31st July, 1837, the weather was moderate; several ships sailed on Tuesday the 1st of August; in the evening the wind was north-east and the weather moderate. On Wednesday the 2d, the wind during the night had shifted to the north; the weather looked squally, cloudy and suspicious, and continued so during the afternoon; the wind shifted gradually to the N. N. W. At 1 P. M. the falling of the barometer, the appearance of the weather, and the increasing wind, left us no doubt of the approaching storm, and it came on from the north-west between 3 and 4 P. M. The mercury continued falling, and the gale increasing, until half past 6 P. M. when the wind became westerly. At 7 P. M. the mercury began slowly to ascend, and yet the storm increased in violence. At 8 P. M. it was blowing a hurricane from the west-south-west to the south-west, coming in furious gusts until 10 P. M., when a certain decrease in their violence had taken place, which abatement continued until Thursday morning the 3d of August, when it blew a fresh gale from the south.

Log of the Water-Witch.

Arrived off St. Thomas on the 2d August; morning squally and the Water-Witch was off St. John's, and standing for St. Thomas's, the wind north and north-north-west. Noon, shipping in the harbour visible; at 1 P. M. squalls violent; at 3 P. M. we had beat up within half a mile of the forts, when we could proceed no further from the violence of the squalls, and anchored in ten fathoms water; sent down top-gallant-yards, &c.; did not suspect a hurricane. At 5 P. M., squalls ceased, and began a heavy gale of wind, at that time off the land. At 7 P. M. a hurricane beyond all description, dreadful; the windlass capsized, and I could not slip my cables, ship driving until I was in twenty fathoms water; a calm then succeeded for about ten minutes, and then in the most tremendous unearthly screech I ever heard, it recommenced from the south and south-west. I now considered it all over with us, for the wind was directly on shore, and the sea rose and ran mountain high. At 2 A. M. the gale abated somewhat, and the barometer rose an inch; at day-light, out of forty vessels, the Water Witch and one other were the only two not sunk, ashore, or capsized.

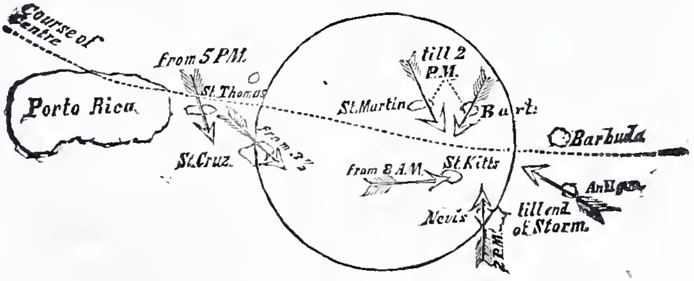
Porto Rico.

At 4 P. M. on the 2d of August, 1837, in consequence of having observed the barometer falling, I ordered all the vessels in the harbour, to prepare for stormy weather, although the fall of the barometer was not great.

At 8 P.M.	the barometer was at	29.6	At 12 midnight,	barometer at	28.00
9 "	"	29.5	1½ A. M.	"	29.17
10 "	"	29.4	4 "	"	29.50
11 "	"	29.3			

At 9 P. M. the wind was strong N. N. E. At 11 veering to east, and blowing in an alarming and furious degree till midnight, when every vessel was sunk or ashore. At 4, the wind fell, and then veered to the south.

Antigua Hurricane of 2d August, P. M., 1837.



It appears from these accounts that the wind, from some time before 2 P. M. till 2, was blowing inwards to a central space between Antigua and St. Martins, from four different localities, Antigua, Nevis, St. Martins and St. Bartholomew.

It is worthy also of particular remark that the barometer fell at Porto Rico to 28 inches, and rose to 29.17 in an hour and a half. As this storm moved about 10 miles in an hour, it would appear that the barometer was lower in the middle of the storm by 1.17 inches than it was at the distance of fifteen miles, and if so, the velocity of the up-moving column in the middle of the storm may be calculated according to the laws of spouting fluids, and will be found to be upwards of 260 feet per second. From this the quantity of vapour condensed in a second may be calculated.

Barbadoes Hurricane of 26th Juy, 1837. *At Barbadoes,*

At 2 o'clock A. M. of 26th July, light showers of rain, wind shifting from south to north-west, the sky dark and gloomy, with flashes of lightning in the south-east and south-west. At 4, calm with a heavy swell rolling into the bay; lightning and thunder, sky assuming a black appearance, with a red glare at the verge of the horizon; every flash of lightning with an unusual whizzing noise, like that of a red hot iron plunged in water; at 6, the barometer fell rapidly, the sympiesometer much agitated and unsettled, and fell at length to 28.45. At 7.30 the hurricane burst on us in all its dreadful fury; at 8 it shifted from east-south-east to south, and blew for half an hour, so that we could hardly stand on deck—the wind shifting to south-west, at 9 the barometer began to rise, and to our great joy we saw a change in the sky for the better. As the haze cleared away, we counted twenty-one sail driven on shore.

At St. Vincent.

Our paper from St. Vincent informs us that the gale of the 26th July was severely felt there; the wind being from the west and south with a heavy swell of the sea.

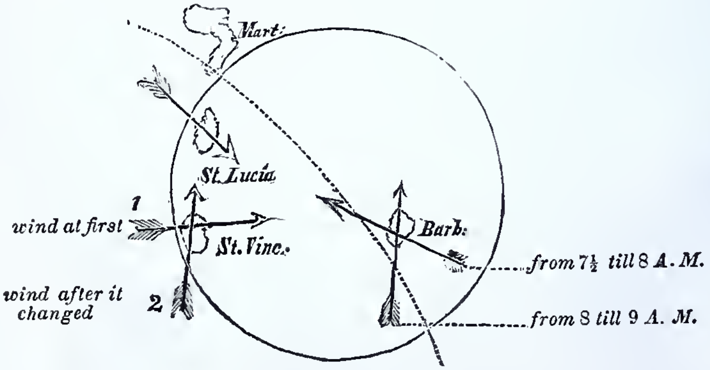
At St. Lucia.

We have experienced a severe gale from the north-west, which lasted several hours.

At Martinique.

Martinique suffered a severe gale on the 26th July, from the south-east. The tempest raged there at 10 P. M., at which hour all was calm at Barbadoes.

When the storm was raging at Martinique, it was calm at Barbadoes. The wind at Barbadoes commenced from the N. W.



It is evident that the wind in all these four storms, blew inwards from the circumference towards a central space of no great magnitude. I shall at some future time examine the other hurricanes in which simultaneous observations can be found, and I hope to show some strong cases in favour of an inward motion. There is one which I have already examined, which is more striking than any of the four here given; I mean that of the 18th of August, 1837. I have been able to add from the American newspapers some observations on that storm, which will render the phenomena much more striking. These observations are copied here for the sake of those who may have Col. Reid's book, who can then examine the storm for themselves.

The Philadelphia Commercial Herald of 28th of August, says "barque King Philip on the 18th of Aug. lat. 31° 12′, long. 78° 16′, gale from N.N.E. to W.N.W.

The same paper of 29th of Aug., says "brig Oglethorpe, on the 18th of Aug. lat. 32° 29′, long. 78° 55′ had a violent gale from N.W."

If the reader will now turn to Col. Reid's account of this storm and mark with his pencil on the chart the direction of the wind on the 18th of Aug., 1837, he will find that the arrows of the following places all point inwards, towards a space where the West Indian and the Duke of Manchester were labouring in the centre of the storm at that time. The Oglethorpe, the Ida, the Rawlins, the Cicero, the Delaware, the Mary, the Westbrook, the Sophia, and at Wilmington. He will moreover observe that the localities are all round the centre, several hundred miles apart, as favourably situated as could be desired for ascertaining the direction of the wind in this storm at a particular time.

The reader will find but two arrows which do not point towards this central space; the Penelope, which seems to indicate a rotation of the wind from right to left; and the Winchester, which seems to indicate a rotation from left to right. These anomalies I hope to explain satisfactorily, and in such a manner as to add a strong link to the chain of argument in favour of an inward motion of the air towards the centre of the storm, if indeed any other evidence, than that of the fact itself, is necessary.

Now if the wind did blow inwards in all these storms, all the phenomena can be accounted for, from the single fact which I have demonstrated from experiment, as indicated in a publication of mine in the Saturday Courier of March 18, 1837.

For as the air must have moved upwards over a central space of undefined magnitude in all these storms, I have demonstrated by experiment that the cold due to diminished pressure, would condense one half its vapour when it reached six thousand yards, a quantity sufficient in ordinary states of the dew-point to produce three inches of rain in that climate. The condensation of this vapour, as I have demonstrated by experiment, would give out into the air in contact with the condensing vapour, caloric of elasticity sufficient to expand that air between five and six thousand cubic feet for every cubic foot of water generated, after making allowance for the diminished volume due to the condensation of the vapour itself into water.

This will cause the barometer to fall more than two inches in the centre of the storm, and to rise all round on the outside of the storm especially on that side towards which the top of the cloud is pressed by the upper current of the atmosphere into which the cloud penetrates—and that will be the direction in which the storm will move along the surface of the earth; all which I have elsewhere shown.

As the cloud moves along, being pushed by the upper current, the air under the cloud will, on account of the specific levity of the cloud, ascend, and thus the action will be continued. Moreover I have demonstrated from experiment that if the barometer falls two inches under the base of one of these clouds, the air will not have to ascend so high, by eight hundred yards, before it begins, by the cold of diminished pressure, to form cloud—and this in many cases, will bring the cloud down on the surface of the sea; or in other words the vapour of the air in the outside of the storm will begin to condense, as soon as it comes under the base of the cloud, from the cold produced by diminished pressure there.

It is not a little remarkable that all these storms and others which have been traced in the West Indies, traveled towards the N. W. almost at right angles to the direction of the trade wind in those latitudes; but very nearly, if not exactly, in the direction of an upper current of the air, known to exist there towards the N. W. The direction of the trade wind, will therefore produce an oblique force, which will cause the wind to set in at the beginning of these storms, not exactly towards the centre of them, but towards a point west of that centre, and if this single circumstance should be observed without attending to all the phenomena, it would undoubtedly give rise to a suspicion, that the wind in these storms rotates from right to left. And if to this circumstance be added, that these storms are nearly round in this latitude, and that the air at some moderate distance around them is nearly calm, the investigator will be confirmed in his first impression, and perhaps not even think it worth while to mark on his chart, by arrows, the course of the wind in the simultaneous observations at his command. And if to all this is added his belief, that the air in a cloud is denser and heavier than surrounding air at the same elevation, he will consider that it amounts to absolute demonstration, that there must be a whirl, as that is the only possible means of causing a depression of the barometer under all these circumstances in the middle of the storm. Again, if he believes that the cold air from above, coming down in the centre of the whirlwind, which it would do, mingles with the warm air below, and thus produces condensation of its vapour, he thinks he has got hold of a fact, which enables him to explain many phenomena connected with the storm, though the whirlwind itself remains unexplained, as it always must. But if he will examine this subject a little more minutely, he will find, that if air should descend from a height sufficiently great to double its density at the surface of the earth, its dew-point will be raised only 20°, and its temperature by increased pressure above 80°, and that it will then be extremely dry, even if it had been saturated at the commencement of its descent. In fact, it would then be able to contain about eight times as much vapour as it contained before its descent; for at these low temperatures every increase of temperature of 20° doubles its power of containing vapour, as may be ascertained by looking at a table of dew-points. In fact the doctrine of mingling air in the atmosphere to produce cloud, as taught by Dr. Hutton, will not stand the test of examination, even if a means could be discovered of producing the mixture. For it must be done either by cold air coming down, or warm air going up—now if cold air comes down, it becomes intensely dry, and if warm air goes up, it will condense its vapour by the cold of diminished pressure, and more so the less it mingles with the upper air. Nor is the doctrine that cloud is heavier than surrounding air at the same height tenable, as was shown before.

The question then resolves itself into a matter of fact: and a question of great moment it is acknowledged to be—is there a centripetal or a centrifugal motion of the air in these storms? If the former is true, all the phenomena are explained; if the latter, nothing is explained; not even the whirling motion itself. Let the careful reader decide.